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(54) FLUID PRESSURE-OPERATED PERCUSSION EARTH BORING DEVICE

(71) I, PAUL SCHMIDT, a German citizen, of Reiherstrasse, 5940 Lennestadt-Saalhausen, West Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fluid pressure-operated, preferably pneumatic, percussion earth boring devices for use in ground boring and comprising a percussion boring tool which is mounted in a tubular housing, a percussion piston which, in operation, reciprocates in the housing and acts on the tool, and a displacement piece which is detachably mounted on the tool by means of an axial bore, through which a section of the tool extends, in the displacement piece.

An example of such a device is disclosed in German Specification 21 57 259. It is mainly intended for laying supply lines such as water piping or cables beneath roads or embankments, without the need for excavating the road surface. This can be done because the percussion earth boring device, as it advances through the soil, displaces the soil laterally and leaves behind it a duct or tunnel in which supply lines can be drawn through, either as boring proceeds or subsequently. During the forward movement of the percussion earth boring device, the percussion tool serves for shattering stones or other obstructions, while the function of the displacement piece is to deflect the soil sideways and thus to form a duct or tunnel having a compacted side wall.

The displacement piece must be firmly seated upon the percussion tool so that it has no freedom of movement relative to the tool in the direction of boring and it must also be capable of easy release from the percussion tool, so that it can be removed when damage occurs and be exchanged for a new displacement piece. To make this possible, in one known percussion earth boring device the displacement piece is seated upon a conical intermediate section of the percussion tool and this section tapers in the direction of boring of the tool so that it is firmly fixed without additional means on the percussion tool, but it can be easily removed from the tool by moving it relative to the tool in a direction opposite to the boring direction. It has however been found in practice that this type of fixing is not satisfactory, especially because, when the earth boring device leaves the end of the bore hole as its drive is completed, the displacement piece tends to become loosened from the tool on account of its kinetic energy.

The aim of the present invention therefore is to provide a percussion earth boring device of the type initially referred to, wherein the displacement piece is fixed by simple means to the percussion tool and can also be easily released from the tool.

To this end, according to this invention, in such an earth boring device, the section of the tool and the axial bore in the displacement piece have mating screw threads by which the displacement piece is held in position on the tool.

In this way, a simple, but extremely reliable fixing is obtained between the displacement piece and the boring tool so that releasing of the displacement piece from the boring tool as the tool emerges from the end of the bored hole is impossible. Preferably, the screw threads have a fine pitch.

It has proved to be especially advantageous if the axial bore is provided with the screw thread over part only of its length and the section of the tool is provided with the screw thread only over a corresponding part of its length.

The axial bore in the displacement piece and the section of the boring tool may be of cylindrical form, since a sufficient fixing can be obtained by means of the mating screw threads alone. Preferably, however, a part of the axial bore which is not screw-threaded is conical and a corresponding part of the section of the tool is also conical and fits in the conical part of the bore, the conical parts being in front of the screw-threaded parts and having their ends of larger diameter adjacent the screw-threaded parts. As a result of the wedge effect thus obtained, a very good fixing of the displacement piece

is obtained, when by tightening of the screw threads, the displacement piece is drawn on to the conical surface of the boring tool.

Detent means provided to secure the screw thread on the displacement piece and the screw thread on the tool to each other has proved especially advantageous, a flexible plastics ring, an adhesive or a securing band acting between the two screw threads being suitable, for example, for this detent means. In this way the axial position of the displacement piece upon the boring tool, when once adjusted, can be maintained.

An example of a percussion earth boring device together with a modification in accordance with the invention are illustrated in the accompanying drawings, in which:—

Figure 1 is a longitudinal section through the device; and,

Figure 2 is a longitudinal section to a larger scale through a modified displacement piece which can be fitted to the device shown in Figure 1.

A percussion earth boring device shown in Figure 1 comprising a tubular housing 2, in the forward end of which a bushing 3 is screwed. A percussion tool 4 is axially displaceably mounted in the bushing 3. The percussion tool 4 is acted upon by a spring 5, which engages upon a thickened head 6 of the percussion tool 4. On the side of the percussion tool 4 remote from the spring 5, there is a spigot 7, which is guided in a disc 8 inserted in the housing 2. The percussion tool 4 carries, in its region situated outside the housing 2, a forwardly tapering displacement piece 9 having a central mounting bore 11 which is in part seated upon a conical intermediate section 36 of the percussion tool 4 and in part on a cylindrical section 12 of the tool 4. A fixing device 13 retains the displacement piece 9 axially in position upon the percussion tool 4.

The percussion tool 4, which may, for example, be constructed as a hollow chisel, is driven forward together with the displacement piece 9, the spring 5 being compressed, when a blow is applied in a forward direction to the spigot 7. While the chisel-like portion of the percussion tool 4 serves for shattering stones or other obstructions, the function of the displacement piece 9 is to deflect the soil sideways and to form a duct or tunnel having a compacted wall. In this way, during the advancing movement of the earth boring device, a consolidated duct or tunnel is formed, into which supply lines can be pulled either immediately following the earth boring device or later on.

Inside the tubular housing 2 is a reciprocating percussion piston 14. The piston 14 has forward and rear guide rings 15, 16, with slide rings set in them. Whereas the rear guide ring 16 needs to be completely sealed to the housing 2 by means of its slide ring, the forward guide ring 15 has one or more axial grooves 19, so that during a longitudinal displacement of the percussion piston 14, the air expelled in front of it can flow backwards over its surface. In the rear part, the percussion piston 14 is provided with an internal cylindrical chamber 21, which is bounded by a percussion piston sleeve wall 22. Control ports 23 are distributed around the circumference of the wall 22, these ports constituting a communicating passage between the cylindrical chamber 21 or the free atmosphere and the external, forward space of the percussion piston 14.

A control piston 24, which in operation of the boring device remains stationary, extends from behind into the internal cylindrical chamber 21 of the percussion piston 14, and compressed air is supplied to this control piston from the rear end of the earth boring device via one or more internal ducts 25. This air emerges at the forward face of the control piston 24. The rearward extension of the control piston 24 is held in a clamp fixing 26 having, at its periphery, axial air passages 27. At the rear end of the housing 2, the extension of the control piston 24 is connected in an airtight manner to a compressed air hose 28, which leads to a compressor, not shown. The compressed air hose 28 is surrounded by a sleeve and a protective tube.

The above-mentioned fixing 13 consists, firstly of a screw-threaded bore 32 extending over a portion of the length of the mounting bore 11 (Fig. 2) and secondly of a corresponding screw-threaded part 33, situated upon the intermediate section 12 of the percussion tool 4 (Fig. 1). As can be seen from Figure 2, the screw-threaded bore 32 is situated in the rear part of the displacement piece 9. Coaxial with the threaded bore 32 inside the displacement piece 9, is a conical bore 34, the end of larger diameter of which is adjacent the threaded bore 32. Between the screw-threaded bore 32 and the conical bore 34, there is also an annular groove 35. The percussion tool has a bearing section 36, corresponding to the conical bore 34. To secure the displacement piece 9 axially upon the percussion tool 4, a detent may be used, for example a soft plastics ring inserted between the turns of the mating screw threads, or an adhesive, or a securing band.

The displacement piece 9 is tightened on to the percussion tool 4 by means of an implement. For this purpose, the displacement piece has an adjustment connection in the form of radial blind bores 37 for receiving the implement, disposed on the outer face of the displacement piece 9. The percussion tool 4, by contrast, is provided on its forward part with flat key faces 40, on opposite sides, so that the displacement

piece can be easily screwed on while the tool is held by a spanner. The displacement piece 9 can, as shown in Figure 1, have a smoothly curved continuous peripheral surface; it may alternatively, as shown in Figure 2, be furnished at its periphery with step-shaped cutters 38.

Normally, the percussion tool 4 together with the displacement piece 9 is held in the position shown in Figure 1 by a spring 5. When the earth boring device is supplied with compressed air through the control piston 24, the percussion piston 14 is moved forwards, so that it strikes the spigot 7 of the percussion tool 4. As a result, the percussion tool 4 together with the displacement piece 9 is moved forwards and driven into the soil. As soon as the percussion piston 14 has been withdrawn again by the compressed air acting on its forward face, the percussion tool 4 together with the displacement piece 9 also returns to its starting position under the action of the spring 5, the displacement piece being guided by an elastic disc disposed between it and the bushing 3.

WHAT I CLAIM IS:—

1. A fluid pressure-operated percussion earth boring device comprising a percussion boring tool which is mounted in a tubular housing, a percussion piston which, in operation, reciprocates in the housing and acts on the tool, and a displacement piece which is detachably mounted on the tool by means of an axial bore, through which a section of the tool extends, in the displacement piece, wherein the section of the tool and the axial bore in the displacement piece have mating screw threads by which the displacement piece is held in position on the tool.

2. A boring device according to claim 1, in which the screw threads have a fine pitch.

3. A boring device according to claim 1 or claim 2, in which the axial bore is provided with the screw thread over part only of its length and the section of the tool is provided with the screw thread only over a corresponding part of its length.

4. A boring device according to claim 3, in which a part of the axial bore which is not screw-threaded is conical and a corresponding part of the section of the tool is also conical and fits in the conical part of the bore, the conical parts being in front of the screw-threaded parts and having their ends of larger diameter adjacent the screw-threaded parts.

5. A boring device according to claim 4, in which an annular groove is disposed between the screw threaded part and the conical part of the axial bore.

6. A boring device according to any one of the preceding claims, in which detent means is provided to secure the screw thread on the displacement piece and the screw thread on the tool to each other.

7. A boring device according to claim 6, in which the detent means is a flexible plastics ring, an adhesive or a securing band acting between the two screw threads.

8. A boring device according to any one of the preceding claims, in which means for engagement by a turning implement is provided on the displacement piece.

9. A boring device according to claim 8, in which the means for engagement by the implement consists of two diametrically opposite blind bores in the periphery of the displacement piece.

10. A boring device according to any one of the preceding claims, in which the boring tool is provided near its front end with two diametrically opposite flat faces for engagement by a spanner.

11. A boring device according to claim 1, substantially as described with reference to Figure 1, or Figure 1 modified substantially as described with reference to Figure 2, of the accompanying drawings.

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Fig. 1

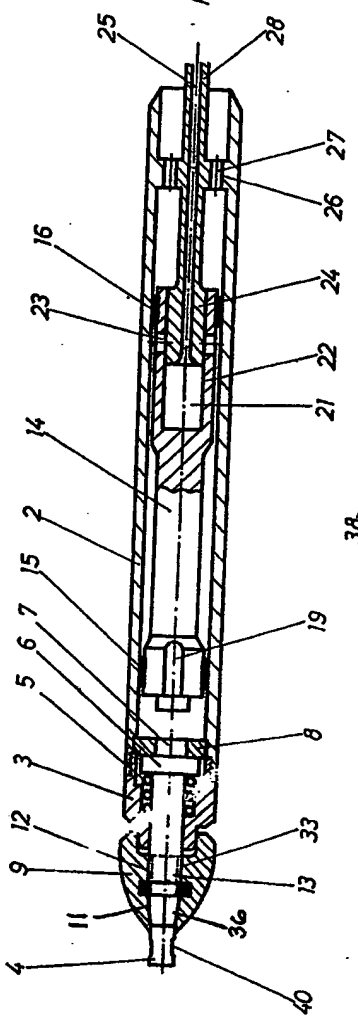

Fig. 2